

Health Consultation

Washougal Compressor Station

Clark County, Washington

September 30, 1999

**Prepared by
The Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry**



FOREWORD

The Washington State Department of Health (DOH) has prepared this Health Consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This Health Consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this Health Consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. The Health Consultation allows DOH to respond quickly to a request from concerned residents for health information on hazardous substances. It provides advice on specific public health issues. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For additional information or questions regarding DOH, ATSDR or the contents of this Health Consultation, please call the Health Advisor who prepared this document:

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Background and Statement of Issues

The Washington State Department of Health (DOH) has prepared this health consultation in response to community health concerns relative to air emissions from the Washougal Compressor Station. This health consultation evaluates existing ambient air modeling data to determine whether air contaminants originating at the compressor station pose a public health hazard to nearby residents. DOH prepared this health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

The Washougal Compressor Station is operated by the Northwest Pipeline Corporation (NPC) and is located at 1309 NE Brown Road north of Washougal in Clark County, Washington. The station is bordered to the south by an odorizing station, to the north by a former residence recently purchased by NPC, to the east by an unoccupied residence and to the west by NE Brown Road (see Appendices A and B). The station was built in 1971 to provide the necessary compression to move natural gas through the pipeline from gas fields in Canada and New Mexico. It operates remotely from Salt Lake City, Utah and contains a reciprocating engine-driven compressor, gas turbine, boiler and emergency power generator. The reciprocating engine and turbine each have exhaust stacks which produce a majority of the air emissions. This equipment is fueled by natural gas from the pipeline. The gas is not odorized until it reaches the Northwest Natural Gas Company odorizing facility located approximately 750 feet south of the station.¹

Staff from DOH and the Southwest Air Pollution Control Authority (SWAPCA) visited the site on October 16, 1998, accompanied by an employee of NPC (see photographs in Appendix C). Neither the turbine nor the reciprocating engine were operating at the time of the visit. A slight sulfur odor was noticed on-site but no odors were noticed off-site. The odorizing station located just south of the site was also visited. A slight sulfur odor was noticeable in the tank storage building that houses approximately 2,500 gallons of odorizing agent (mercaptan). However, no odors were noticed outside among the network of gas lines where the mercaptans are injected into the natural gas received from the compressor station.

Community health concerns have been expressed to various state and local agencies including ATSDR and DOH regarding air emissions from the station. Several health concerns are documented and responded to in the Technical Support Document and Responsiveness Summary released by SWAPCA in April 1998.¹ The report concludes that air emissions from the station do not exceed National Ambient Air Quality Standards (NAAQS) and do not pose a significant health risk to nearby residents. The report suggests that other point and non-point sources of air pollution may be the cause of health impacts experienced by residents.

Nearby residents are also concerned with a perceived increase in allowable emissions under a new permit issued to the station. However, much of the increase in allowable emissions under the new permit is due to better testing methods and not an actual increase. In addition, the report notes that estimated ambient air levels are expected to decrease when emission

stack heights are raised. In March 1999, the turbine stack height was increased from 60 to 84 feet and the reciprocating engine stack increased from 52.4 to 84 feet.

The conclusions given in the SWAPCA report are based on air dispersion modeling of maximum permitted emissions that predicts levels of ambient (i.e., outdoor) air contaminants originating from the station. Although outdoor air sampling has not been conducted at the site, the model is expected to give reasonable “worst-case” estimates of ambient air contaminant levels at nearby residences. The contaminants of concern are carbon monoxide, nitrogen oxides (NO_x), sulfur dioxide (SO₂), particulate matter, hydrogen sulfide, mercaptans, benzene, mercury and formaldehyde. Maximum concentrations of these air contaminants were estimated to occur north and east of the compressor station.

As shown in Figure 2, Residences A and C border the station to the north and east, respectively. The recent purchase of Residence A by NPC has eliminated exposure at this residence. Residence C has not yet been occupied. Table 1 gives the maximum levels of air contaminants estimated for off-site locations both before and after stack height increases. Also shown in Table 1 are the maximum levels estimated, for Residence B prior to stack height increases. Residence B is located approximately 300 feet to the south of the station.²

Table 1. Estimated outdoor air levels of contaminants of concern originating from the Washougal Compressor Station

	After Stack Height Increase		Prior to Stack Height Increase									
Contaminant	Current Maximum Concentration ^a (ug/m3)		Former Maximum Concentration (ug/m3)		Concentration at Residence B (ug/m3)		Comparison Value ^b (ug/m ³)		Source of Comparison Value ^c	Background Level ^d (ug/m3)		Source of Background Level
	1-hour	Annual	1-hour	Annual	1-hour	Annual	1-hour	Annual		1-hour	Annual	
Criteria Air Pollutants												
Carbon Monoxide	30.3	27.3 (8 hr)	124.4	111.9 (8 hr)	3.1	NA	40,100	10,300	NAAQS (8 hour)	6,756	5,039	Ref. 3
Nitrogen oxides	42.0	3.4	177.9	14.2	NA	0.35	470	100	CARB/ NAAQS	48.9	9.4	Ref. 3
Sulfur dioxide	17.2	0.1	17.2	0.4	0.77	0.01	1050	53	WSAQs	107.4	13.1	Ref. 3
Particulate Matter (PM10)	NA	0.7	12.7	2.5	NA	0.06	150 (24 hr)	50	NAAQS	40 (24 hr)	18	Ref. 3
Non-Criteria Air Pollutants												
Formaldehyde	3.6	0.3	13.2	1.1	0.24	0.024	60	0.08	CREG	NA	1.0	Ref. 4
Benzene	NA	0.007	NA	0.012	0.003	0.0003	160	0.13	IRIS	NA	0.47	Ref. 5
Mercury	NA	0.012	NA	0.012 (24 hr)	0.002	0.0007 (24 hr)	NA	0.2	EMEG	NA	0.002	Ref. 6
Mercaptans	NA	NA	NA	NA	0.002	0.0002	700	1	RfC (hydrogen sulfide)	NA	NA	NA
Hydrogen sulfide	NA	NA	NA	NA	2 x 10 ⁻⁵	2 x 10 ⁻⁶	700	1	RfC	NA	0.15	Ref. 7

Bold indicates a contaminant concentration that exceeds its comparison value.

a = Represents the maximum modeled concentrations after stack height increases.

b = Comparison values for non-criteria pollutants are based on acute and chronic exposure for comparison with 1-hour and annual average concentrations, respectively.

c = See glossary for definitions. The comparison value given for mercaptans is based on hydrogen sulfide.

d = Background levels for criteria air pollutants represent 1997 average measurements from rural or suburban locations in Washington State. Background levels for non-criteria pollutants represent rural measurements from across the county. ^{3,4,5,6,7}

Discussion

Community concern over contaminants released from the Washougal Compressor Station have previously been addressed by estimating levels of these contaminants at nearby residences.¹ Estimates using computer modeling by SWAPCA and Ecology place the location of the highest off-site contaminant levels north and east of the compressor station. Since Residence A was formerly located to the north, it assumed that residents could have been exposed to these maximum levels. Residence A has since been purchased by the owners of the station and Residence C is not yet occupied but represents a potential receptor point for future exposure. Specific health concerns were expressed by an occupant of Residence B and, therefore, emissions from the compressor station were modeled for impacts on ambient air at this residence.

As shown in Table 1, only formaldehyde exceeds its respective health comparison value for the maximum contaminant levels predicted. Estimated levels at Residence B exceed no comparison values. Contaminant levels that are below respective health comparison values are not expected to cause any adverse health effects while those that exceed health comparison values need further evaluation. It is important to note that health comparison values typically include conservative or health-protective assumptions. An ambient air concentration that exceeds a health-based comparison value does not necessarily indicate a health concern. The potential health risk associated with the predicted levels of air contaminants originating from the Washougal Compressor Station are discussed below.

Criteria Air Pollutants

Past, current and future emissions of criteria air pollutants from the compressor station are not expected to result in any adverse health effects for nearby residents. However, the health comparison values used to assess the potential for adverse health effects may not be protective of sensitive populations. Exposure of sensitive populations is discussed below on page 7.

The criteria air pollutants are those chemicals which are required to be monitored in outdoor air by the federal Clean Air Act. They include sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter (PM₁₀ and PM_{2.5}), lead and ozone. All of these contaminants are expected to be released from the compressor station except lead and ozone. However, ozone can be formed from nitrogen oxides once released into the atmosphere. The estimated concentrations of these pollutants associated with emissions from the plant are below health comparison values and regional background levels. The health comparison values given in Table 1 for the criteria air pollutants are federal and state standards based on health effects that could result from both short- and long-term exposure.

Non-criteria Air Pollutants

Past, current and future emissions of non-criteria air pollutants from the compressor station are not expected to result in any adverse health effects for nearby residents. The non-criteria air pollutants listed in Table 1 are all well below both health comparison values and national

background levels for rural areas except for formaldehyde. It should be noted that formaldehyde did not exceed its comparison value at Residence B.

Exposure of residents to the maximum levels of formaldehyde predicted for off-site locations is considered to pose only a very low increase in cancer risk. Formaldehyde is classified by the Environmental Protection Agency (EPA) as a Group B1 probable human carcinogen based on sufficient evidence in animals and limited evidence in humans. A very low increased cancer risk was estimated for a person exposed over a 28-year period to past and current maximum levels of formaldehyde in air. This represents a worst-case scenario since the station was constructed in 1971. Exposure for only a few years (i.e., < 5 years) is not expected to result in a significant cancer risk.

Cancer Risk		
Cancer risk estimates do not reach zero no matter how low the level of exposure to a carcinogen. Terms used to describe this risk are defined below as the number of excess cancers expected in a lifetime:		
Term	# of Excess Cancers	
low	is approximately equal to	1 in 10,000
very low	is approximately equal to	1 in 100,000
slight	is approximately equal to	1 in 1,000,000
insignificant	is less than	1 in 1,000,000

It is important to note that formaldehyde is ubiquitous in both outdoor and indoor air. A background level of formaldehyde in outdoor air is given in Table 1. This background level is based on air measurements taken in a rural area of the United States and is greater than the maximum level predicted to result from current operation of the compressor station. This comparison suggests that the formaldehyde emissions from the compressor station will not significantly increase air levels above what might be expected in other rural areas of the country.

Children and Other Sensitive Populations

Some people are more likely than others to experience health problems related to contaminants in the environment. The developing fetus, infants and young children are generally considered to be more sensitive to environmental contaminants than older children or adults since developing organs can be damaged at lower levels of exposure. In addition, children breathe more air than adults per body weight and so receive a higher dose of air contaminants. Asthmatics and the elderly are other sub-populations sensitive to air pollution and can experience adverse health effects at levels below comparison values.

Most of the pollutants listed in Table 1 are respiratory irritants including sulfur dioxide, nitrogen oxides, particulate mater, formaldehyde, mercaptans and hydrogen sulfide. As indicated previously, only *formaldehyde* exceeds its health comparison value. This comparison value is based on cancer risk and indicates that maximum formaldehyde levels both before and after stack height increases contribute a very low excess cancer risk for a person exposed over a long period of time. It is not clear whether this cancer risk would be increased for persons sensitive to irritating air pollutants. The *non-cancer* effects of formaldehyde have also been well studied. The maximum formaldehyde level predicted prior to stack height increases is approximately four times lower than the non-cancer comparison value published by ATSDR. ⁴

It is unlikely that even sensitive individuals would experience adverse health effects if exposed to current or past formaldehyde emissions from the compressor station.

There is evidence that nitrogen dioxide (one of several nitrogen oxides) can exert adverse effects on the respiratory system of children exposed over long periods of time to indoor air levels as low as 15 ug/m³.⁸ The maximum level of nitrogen oxides (NOx) estimated for off-site locations prior to stack height increases is 14.2 ug/m³. However, this exposure would have been in addition to that associated with other outdoor sources in the area as well as indoor air sources (e.g., gas stoves). Nearby paper mill emissions were predicted to result in a nitrogen oxide level of 22.3 ug/m³ in outdoor air at residences near the compressor station. Although outdoor air levels of nitrogen oxides may exceed 15 ug/m³, the data cited above suggest that only the most sensitive children would be at risk for respiratory ailments.

It is important to note that the estimated levels attributed to the compressor station and the paper mill are based on worst-case assumptions about weather patterns and contaminant dispersion in air and actual levels are likely to be lower. In addition, the contribution of nitrogen oxides from the compressor station was reduced 4-fold by recent stack height increases. *It is, therefore, possible but unlikely that children living near the compressor station will experience adverse respiratory effects from nitrogen oxides.*

None of the other contaminants of concern are expected to cause any adverse health effects for sensitive persons exposed at any location. Past and current estimated maximum air levels for *sulfur dioxide* and *particulate matter* attributable to the compressor station are well below comparison values and, therefore, not expected to contribute to airway irritation. Although levels of mercaptans and hydrogen sulfide were not estimated for points north and east of the station, the predicted concentrations at Residence B indicate that these compounds will not approach levels of health concern in any nearby residences.

Ambient Air Sampling

Air pollutant levels originating from the Washougal Compressor Station were estimated using a worst-case scenario. Actual levels are likely to be lower. Outdoor air sampling would provide little information relative to the source of the air contaminants detected. Since other sources in the area are expected to contribute to outdoor air contamination, modeling of emissions is the most effective method of determining the contribution of specific sources.

Other Sources of Air Emissions

Other sources of air pollution exist in the area of the compressor station, including a paper mill located in Camas, Washington and an aluminum reduction plant located in Troutdale, Oregon (see Figure 3). A comparison of modeled emission data from these two facilities with the compressor station shows the paper mill to be the largest contributor of criteria air pollutants to ambient air near the compressor station. However, emissions from the mill remain within regulatory standards for this area.¹ No modeling data are available for non-criteria pollutants emitted from the aluminum reduction plant or the paper mill.

The odorizing facility located just south of the compressor station is a *potential* source of mercaptan exposure. This facility stores and adds large quantities of odorant to gas pumped from the compressor station. The odorant is a mix of organic sulfur compounds and typically contains 70-80% t-butyl mercaptan and 18-22% methyl-ethyl sulfide.⁹ Only a slight sulfur odor was noted inside the tank storage building during the site inspection. No monitoring or modeling data are available to estimate exposure of nearby residents to sulfur compounds that might escape from the odorizing station.

Community Health Concerns

Community health concerns have been communicated to SWPCA, Ecology and DOH from residents living near the compressor station. One resident recorded health complaints while living at Residence A but no correlation was evident between the dates of these complaints and operation of the compressor station.¹ As noted above, it is unlikely that the compressor station contributed significantly to any adverse respiratory effects experienced by nearby residents.

Conclusions

No apparent public health hazard exists from past, current or future exposure to air pollutants originating from the Washougal Compressor Station. Maximum levels of air contaminants estimated at nearby residences are all well below health criteria except for formaldehyde. The very low cancer risk estimated for formaldehyde is based on long-term exposure to the maximum predicted concentration located northeast of the station. It is important to note that the outdoor air level of formaldehyde currently attributable to the station is lower than background levels measured in other rural areas.

It is possible that children, the elderly, asthmatics or other persons with existing respiratory complications living near the compressor station could experience adverse respiratory effects due to combined emissions from various sources in the area. Current operation of the compressor station, however, is not expected to result in a significant contribution of contaminants to outdoor air in any off-site areas due to recent stack height increases.

An indeterminate public health hazard exists for residents living near the Washougal Compressor Station who are exposed to air pollutants originating from sources other than the compressor station. Emissions from a nearby pulp mill and aluminum plant have been evaluated for their contribution to outdoor air levels of criteria air pollutants near the compressor station. However, the impact of non-criteria emissions from these sources has not yet been established for this area. The contribution of air pollutants from other sources is not known.

Recommendations

Air emissions from point sources other than the Washougal Compressor Station should be evaluated for their impact on residents living near the compressor station. Exposure to criteria and non-criteria air pollutants from these sources should be quantified to better assess potential health impacts in this area.

- Ecology is currently evaluating the potential impacts of other point sources on ambient air in the area near the compressor station.

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3. Washington State Department of Ecology. 1997 Air Quality Data Summary. Publication Number 98-212. January 1999.
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6. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Mercury. May 1994.
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8. US Environmental Protection Agency. Air Quality Criteria for Oxides of Nitrogen. Volume I of III. August 1993. EPA/600/8-91/49aF.
9. Natural Gas Odorizing Inc. Material Safety Data Sheet. RP CAPTAN (V).

GLOSSARY

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than 2 weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.
Cancer Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a <i>comparison value</i> used to select contaminants of potential health concern and is based on the <i>cancer slope factor</i> (CSF).
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption or inhalation. It is calculated per kilogram of body weight per day.
U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure may be short-term (acute) or long-term (chronic).
Integrated Risk Information System (IRIS)	A database of cancer and non-cancer toxicity values for a wide range of chemicals maintained by EPA that includes oral reference doses (RfDs), inhalation reference concentrations (RfCs) and Cancer Slope Factors (CSFs).
No apparent public health hazard	Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
Inhalation Reference Concentration (RfC)	A concentration of a contaminant in air below which non-cancer health effects are not expected to occur.